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(iii) The following Tier 0 emission standard applies for engines of a type or model of which the date of manufacture of the first individual production model was on or before December 31, 1995 and for which the date of manufacture of the individual engine was on or before December 31, 1999.

Oxides of Nitrogen: $(40 + 2(\text{rPR}))$ grams/kiloneutron rO.

(iv) The following Tier 2 emission standard applies for engines of a type or model of which the date of manufacture of the first individual production model was after December 31, 1995 or for which the date of manufacture of the individual engine was after December 31, 1999:

Oxides of Nitrogen: $(32 + 1.6(\text{rPR}))$ grams/kiloneutron rO.

(v) The emission standards prescribed in paragraphs (d)(1) (iii) and (iv) of this section apply as prescribed beginning July 7, 1997.

(vi) The following Tier 4 emission standards apply for engines of a type or model of which the date of manufacture of the first individual production model was after December 31, 2003:

(A) Engines with a rated pressure ratio of 30 or less:

(1) Engines with a maximum rated output greater than 89 kilonewtons:

Oxides of Nitrogen: $(19 + 1.6(\text{rPR}))$ grams/kiloneutons rO.

(2) Engines with a maximum rated output greater than 26.7 kilonewtons but not greater than 89 kilonewtons:

Oxides of Nitrogen: $(37.572 + 1.6(\text{rPR}) - 0.2087(\text{rO}))$ grams/kiloneutons rO.

(B) Engines with a rated pressure ratio greater than 30 but less than 62.5:

(1) Engines with a maximum rated output greater than 89 kilonewtons:

Oxides of Nitrogen: $(7 + 2(\text{rPR}))$ grams/kiloneutons rO.

(2) Engines with a maximum rated output greater than 26.7 kilonewtons but not greater than 89 kilonewtons:

Oxides of Nitrogen: $(42.71 + 1.4286(\text{rPR}) - 0.4013(\text{rO}) + 0.00642(\text{rPR} \times \text{rO}))$ grams/kiloneutons rO.

(C) Engines with a rated pressure ratio of 62.5 or more:

Oxides of Nitrogen: $(32 + 1.6(\text{rPR}))$ grams/kiloneutons rO.

(vii) The emission standards prescribed in paragraph (d)(1)(vi) of this

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section shall apply as prescribed beginning December 19, 2005.

(2) Class TSS: Engines manufactured on or after January 1, 1984:

Hydrocarbons = $140(0.92)^{\text{rPR}}$ grams/kiloneutons rO.

(e) Smoke exhaust emissions from each gas turbine engine of the classes specified below shall not exceed:

(1) Class TF of rated output less than 26.7 kilonewtons manufactured on or after August 9, 1985:

$\text{SN} = 83.6(\text{rO})^{-0.274}$ (rO is in kiloneutons) not to exceed a maximum of SN = 50.

(2) Classes T3, T8, TSS and TF of rated output equal to or greater than 26.7 kilonewtons manufactured on or after January 1, 1984:

$\text{SN} = 83.6(\text{ro})^{-0.274}$ (ro is in kiloneutons) not to exceed a maximum of SN = 50.

(3) Class TP of rated output equal to or greater than 1,000 kilowatts manufactured on or after January 1, 1984:

$\text{SN} = 187(\text{ro})^{-0.168}$ (ro is in kilowatts)

(f) The standards in this section refer to a composite emission sample measured and calculated in accordance with the procedures described in subpart G of this part.

[47 FR 58470, Dec. 30, 1982, as amended at 49 FR 31875, Aug. 9, 1984; 62 FR 25365, May 8, 1997; 70 FR 69686, Nov. 17, 2005; 77 FR 36381, June 18, 2012]

§ 87.23 Exhaust emission standards for Tier 6 and Tier 8 engines.

This section describes the emission standards that apply for Tier 6 and Tier 8 engines. The standards of this section apply for aircraft engines manufactured on or after July 18, 2012, except where we specify that they apply differently by year, or where the engine is exempt from one or more standards of this section. Except as specified in paragraph (d) of this section, these standards apply based on the date the engine is manufactured. Where a gaseous emission standard is specified by a formula, calculate and round the standard to three significant figures or to the nearest 0.1 g/kN (for standards at or above 100 g/kN). Where a smoke standard is specified by a formula, calculate and round the standard to the

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nearest 0.1 SN. Engines comply with an applicable standard if the testing results show that the engine type certificate family's characteristic level does not exceed the numerical level of that standard, as described in § 87.60. The tier of standards identified for an engine relates to NO_x emissions and that the specified standards for HC, CO, and smoke emissions apply independent of

the changes to the NO_x emission standards.

(a) New turboprop aircraft engines with rated output at or above 1,000 kilowatts must comply with a smoke standard of $187 \cdot rO^{-0.168}$.

(b) New supersonic engines must comply with the standards shown in the following table:

TABLE 1 TO § 87.23—SMOKE AND GASEOUS EMISSION STANDARDS FOR NEW SUPERSONIC ENGINES

Rated output	Smoke number	HC (g/kN rated output)	NO _x (g/kN rated output)	CO (g/kN rated output)
rO < 26.7 kN	$140 \cdot 0.92^{rPR}$	$36 + 2.42 \cdot rPR$	$4550 \cdot rPR^{-1.03}$
rO ≥ 26.7 kN ..	$83.6 \cdot rO^{-0.274}$ or 50.0, whichever is smaller.	$140 \cdot 0.92^{rPR}$	$36 + 2.42 \cdot rPR$	$4550 \cdot rPR^{-1.03}$

(c) New turbofan or turbojet aircraft engines that are installed in subsonic aircraft must comply with the following standards:

(1) The applicable smoke, HC, and CO standards are shown in the following table:

TABLE 2 TO § 87.23—SMOKE, HC, AND CO STANDARDS FOR NEW SUBSONIC TURBOFAN OR TURBOJET ENGINES

Rated output (kN)	Smoke standard	Gaseous emission standards (g/kN rated output)	
		HC	CO
rO < 26.7 kN	$83.6 \cdot rO^{-0.274}$ or 50.0, whichever is smaller	118
rO ≥ 26.7 kN	$83.6 \cdot rO^{-0.274}$ or 50.0, whichever is smaller	19.6	

(2) The Tier 6 NO_x standards apply as described in this paragraph (c)(2). See paragraph (d) of this section for provisions related to models introduced before these standards started to apply

and engines determined to be derivative engines for emissions certification purposes under the requirements of this part.

TABLE 3 TO § 87.23—TIER 6 NO_x STANDARDS FOR NEW SUBSONIC TURBOFAN OR TURBOJET ENGINES WITH RATED OUTPUT ABOVE 26.7 kN

If the rated pressure ratio is—	and the rated output (in kN) is—	The NO _x emission standard (in g/kN rated output) is—
rPR ≤ 30	26.7 < rO ≤ 89	$38.5486 + 1.6823 \cdot rPR - 0.2453 \cdot rO - 0.00308 \cdot rPR \cdot rO$
	rO > 89	$16.72 + 1.4080 \cdot rPR$
30 < rPR < 82.6	26.7 < rO ≤ 89	$46.1600 + 1.4286 \cdot rPR - 0.5303 \cdot rO + 0.00642 \cdot rPR \cdot rO$
	rO > 89	$-1.04 + 2.0 \cdot rPR$
rPR ≥ 82.6	all	$32 + 1.6 \cdot rPR$

(3) The Tier 8 NO_x standards apply as described in this paragraph (c)(3) beginning January 1, 2014. See paragraph (d) of this section for provisions related to models introduced before January 1,

2014 apply and engines determined to be derivative engines for emissions certification purposes under the requirements of this part.

TABLE 4 TO § 87.23—TIER 8 NO_x STANDARDS FOR NEW SUBSONIC TURBOFAN OR TURBOJET ENGINES WITH RATED OUTPUT ABOVE 26.7 kN

If the rated pressure ratio is—	and the rated output (in kN) is—	The NO _x emission standard (in g/kN rated output) is—
rPR ≤ 30	26.7 < rO ≤ 89	40.052 + 1.5681·rPR – 0.3615·rO – 0.0018·rPR·rO
	rO > 89	7.88 + 1.4080·rPR
30 < rPR < 104.7	26.7 < rO ≤ 89	41.9435 + 1.505·rPR – 0.5823·rO + 0.005562·rPR·rO
	rO > 89	– 9.88 + 2.0·rPR
rPR ≥ 104.7	all	32 + 1.6·rPR

(d) This paragraph (d) specifies phase-in provisions that allow continued production of certain engines after the Tier 6 and Tier 8 standards begin to apply.

(1) Engine type certificate families certificated with characteristic levels at or below the Tier 4 NO_x standards of § 87.21 (as applicable based on rated output and rated pressure ratio) and introduced before July 18, 2012 may be produced through December 31, 2012 without meeting the Tier 6 NO_x standards of paragraph (c)(2) of this section. This also applies for engines that are covered by the same type certificate and are determined to be derivative engines for emissions certification purposes under the requirements of this part. Note that after this production cutoff date for the Tier 6 NO_x standards, such engines may be produced only if they are covered by an exemption under § 87.50. This production cutoff does not apply to engines installed (or delivered for installation) on military aircraft.

(2) Engine type certificate families certificated with characteristic levels at or below the Tier 6 NO_x standards of paragraph (c)(2) of this section with an introduction date before January 1, 2014 may continue to be produced. This also applies for engines that are covered by the same type certificate and are determined to be derivative engines for emissions certification purposes under the requirements of this part.

(3) An engine manufacturer may produce up to six newly manufactured Tier 4 engines on or after July 18, 2012, subject to the provisions of this paragraph (d)(3). Tier 4 engines meeting the criteria of this paragraph (d)(3) are exempted without request from the otherwise applicable Tier 6 NO_x emission standard. To be eligible for this exception the engines must have a date of manufacture prior to August 31, 2013

and be fully compliant with all requirements applicable to Tier 4 engines. The manufacturer must include these engines in the report required by § 87.50. This exception is void for any manufacturer that produces more than six accepted engines under this paragraph.

[77 FR 36382, June 18, 2012, as amended at 77 FR 65823, Oct. 31, 2012]

Subpart D—Exhaust Emissions (In-Use Aircraft Gas Turbine Engines)

§ 87.30 Applicability.

The provisions of this subpart are applicable to all in-use aircraft gas turbine engines certified for operation within the United States of the classes specified beginning on the dates specified.

§ 87.31 Standards for exhaust emissions.

(a) Exhaust emissions of smoke from each in-use aircraft gas turbine engine of Class T8, beginning February 1, 1974, shall not exceed: Smoke number of 30.

(b) Exhaust emissions of smoke from each in-use aircraft gas turbine engine of class TF and of rated output of 129 kilonewtons thrust or greater, beginning January 1, 1976, shall not exceed: $SN=83.6(rO)^{-0.274}$ (rO is in kilonewtons).

(c) The standards set forth in paragraphs (a) and (b) of this section refer to exhaust smoke emissions emitted during operations of the engine as specified in the applicable section of subpart H of this part, and measured and calculated in accordance with the procedures set forth in this subpart.

[47 FR 58470, Dec. 30, 1982, as amended at 48 FR 2718, Jan. 20, 1983]